

The Ganglionic Tissue of the Ileo-Cæcal Junction

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THE presence of nodal tissue at the ileo-cæcal junction, and at other sites in the gut, was postulated by Sir Arthur Keith¹ in an article published in 1915. In another paper² published in the same year, he described in the rat, tissue of this nature between the longitudinal and circular muscle coats of the gut wall. Keith stated that in his opinion this nodal tissue of the gut, which he described as forming a ring or collar around the termination of the ileum, was intermediate in kind between non-striped muscle and sympathetic nerve tissue, and that it was similar in nature to the Keith-Flack node of the heart. Alvarez refers to these observations in his book, "The Mechanics of the Digestive Tract," and states that so far as he is aware "no one has yet confirmed the anatomic findings of Keith." He also states that "he knows of several anatomists who have explored sections of the bowel without being able to satisfy themselves that anything like nodal tissue exists there." As the nodal tissue of the heart and its specialized extensions are intimately related to the initiation and co-ordination of the contraction of the heart, it would be certain that if nodal tissue is present in the gut, it would also be intimately concerned with contractile impulses and thus be of considerable importance in the physiology and pathology of the digestive tract. An investigation was therefore undertaken to search for the tissue described by Keith, and to make an examination of it; though, even before it was begun, it was felt that the mechanics of the two systems, heart and gut, were so different that it was unlikely that the same initiatory and controlling mechanism would exist. It was thought, also, that whatever mechanism did exist would be found in its fullest development at a transitional region of the gut, and especially at a part where not only was a co-ordination required between two segments of the gut, but where also between them there was an active sphincter. The ileo-cæcal junction was therefore selected.

The material studied consisted of serial sections of the whole cæcum and appendix with the terminal portion of the ileum and the beginning of the large intestine of the following animals: *Canis familiaris*, *Felis domesticus*, *Herpestes fasciatus*, *Hapale jacchus*, *Mus albicans*, and *Lepus cuniculus*. It was believed that this series of animals of differing diatetic habits would sufficiently demonstrate any differences of the tissue of the region of the gut.

Search was first made in the sections for the presence of tissue which would correspond to the description given by Keith and Flack³ of the nodal tissue found by them in the heart, that is, of "fusiform striated cells with well-marked elongated nuclei, plexiform in arrangement and embedded in densely packed connective tissue." In the sections which were studied of the terminal ileum, there was no evidence of any trace of this tissue which could be compared, morphologically, to the nodal tissue of the heart, using as standards of comparison sections of the

sinu-atrial node as were used for the illustrations in Quain's Anatomy (The Heart, vol. 4, pt. 3). There is, however, a considerable amount of specialized tissue between this circular and the longitudinal muscle layers, which forms a network collar around the terminal ileum and the ileo-caecal, caeco-appendicular, and caeco-colic junctions, especially where the circular muscle is thickened to form the sphincters of these parts. This specialized tissue, constant in these positions in all the animals studied, and obviously belonging to the myenteric plexus, differs greatly in its gross arrangements through the series studied.

In the dog (*Canis familiaris*) (fig. 1), the tissue occurs in masses of considerable size between the outer longitudinal and inner circular muscle coats. These are present in all parts of the sections, but are largest and most abundant opposite the localized sphincteric thickenings of the circular muscle at the ileo-caecal, caeco-colic, and caeco-appendicular junctions. In sections stained by Mallory's orange G. and wasser blau method, the ganglion cells of the masses are stained orange-red. They are remarkably few in number in each mass, relative to its size, are more numerous next the sphincter, and they are embedded in a large amount of fibrous-looking matrix which is stained a faint blue. The intermuscular and submucous connective tissue elements, on the other hand, are stained a deep blue; this differentiation of the stromal tissues suggests that the matrix of the masses is not a true connective tissue. The ganglion cells vary in size, and are pyramidal or pyriform in shape. Each cell possesses a large oval nucleus, situated at its basal end, and there is a well-defined nucleolus. The cytoplasm of the nucleus has scattered through it numerous coarse granules. The end of the cell away from the nucleus is drawn out into a protoplasmic process which could be followed through, but not beyond the matrix, and in it there is nothing of the nature of striation; it appears rather to be filled with fine acidophilic granules. The matrix, which is fibro-cellular in character—the cell bodies being small in size and the fibres very fine—is distinct from the surrounding tissue, but is not in any way encapsuled; it appears rather to be continuous with, and only with, the fibrous elements of the muscle coats.

In the cat (*Felis domesticus*) (fig. 2), similar masses of the tissue are found in the same muscle plane, and again they are most abundant at the same three sphincteric positions. The matrix of each mass gives the same staining reactions as in the dog, and as before, though there is no evidence of a capsule, it is distinct from the intermuscular fibrous tissue. It is more distinctly fibrous in character than in the dog, and is more freely continuous with the intramuscular fibrous tissue. At one part of the section, shown in fig. 2, the matrix appears to blend and be continuous with the muscle tissue, but after the most careful examination no continuity could be seen, and the matrix tissue presents no myogenic characters. The resemblances to the arrangements of nodal tissue, however, are extremely close.

Similar masses of the tissue are found in the mongoose (*Herpestes fuscatus*) (fig. 3). In their structure and arrangement they resemble the masses present in the dog.

In the common marmoset (*Hapale jacchus*) (fig. 4), the tissue occurs in smaller

masses, and around the ganglion cells there is a less amount of matrix. The masses are scattered in small groups along the whole length of the caecum and proximal colon, and, as before, they are more abundant, and the individual masses are larger, where the circular muscle layer forms the several sphincteric thickenings. The matrix here is much more sharply defined at its periphery from the surrounding muscle and fibrous tissues, and though there is no proper capsule for it, it is isolated from the fibrous elements of the gut wall in the sense that no continuity is established between them. Further, it is less fibrous in its character, and over large parts of it the appearance is granular; the nuclei of the cell bodies, however, are distinct.

In the rat (*Mus albicans*) (fig. 5), the masses of the tissue are still smaller than in any of the types already described. The matrix is much less abundant and its fibrous character is almost totally lost; there is the definite suggestion of a capsule separating it from the surrounding elements of the bowel wall.

In the rabbit (*Lepus cuniculus*) (fig. 6), the masses are still smaller than those in the rat. The amount of the matrix is still further reduced, it is more cellular and granular, and there is a sharp capsule-like limiting membrane. The characters of the masses are those of the usual descriptions of Auerbach's plexus.

SUMMARY.

In the animals studied there are present, therefore, at the end of the small intestine and at the beginning of the large gut, masses of ganglionic tissue between the longitudinal and circular muscle coats. They are most abundant and largest in size at the positions where the circular muscle is thickened to form sphincteric rings, that is, at the ileo-caecal, caeco-appendicular, and caeco-colic junctions. The neural elements of these masses vary in shape and size, but most often they are pyriform or pyramidal, as has already been fully described by Spencer, Johnston, and others in their analyses of Auerbach's plexus. They are contained in a matrix which varies considerably in its amount, in its character, and in its relations to the surrounding tissues, but there are gradation forms between the extreme conditions of the dog and of the rabbit. The masses themselves must represent modifications of the same tissue, and be localized enlargements of Auerbach's plexus, and the matrix throughout its modifications must be the same element of the masses. The demonstration of its constituent cells, however, presents many technical difficulties, and has not, of course, been accomplished by the methods used in the preparation of the sections described in this paper. It is, however, probable that the faint blue staining cells form a protective, supporting, glial tissue; but its interpretation, and the interpretation of its differences, is difficult. The differences do occur in association with highly different forms of intestine, for in the large complex caeco-colon of the rodents the masses are small and isolated, i.e., rabbit, and in the simple large intestine of the carnivores, e.g., dog, the matrix is large in amount and its periphery is undefined. In this description of the tissue, therefore, it is only wished to draw attention to the constancy of its presence in the position described by

Keith, and in comparable positions in the caeco-colon, and to its possible influence on the initiation of movements in the large intestine.

REFERENCES.

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2. KEITH, SIR ARTHUR, 1915, *Br. Journal Surg.*, Vol. 2, p. 576.
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The Physiology of Labour: Some Old and New Views

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EARLY in the history of civilization, man must have found it necessary to anticipate and make provision for new arrivals, both to his own family and also to those of his domestic animals. The discovery would follow that in each animal pregnancy runs a certain fixed course peculiar to the species, and in the great majority of cases its termination can be predicted to within a few days. At the end of this fixed time some hidden change takes places in the organism, with the result that the foetus gives up its tenancy of its mother's uterus and comes to exist as a separate entity. What mechanism has nature provided to initiate a step so vital to both mother and foetus, and when such a process is begun, how is it controlled and regulated so that events follow in a definite and orderly way, leading to the birth of the child, then the expulsion of the placenta, and finally the resumption by the uterus of its original size and condition? The complete investigation of this problem raises a great many issues, but here only one aspect of the birth process will be discussed, namely, the question of the labour pains, how they are elicited and controlled, and what is their significance.

Of all the features associated with child-bearing, probably the labour pains have always attracted most attention. Is it not significant that the very word which we use to denote the termination of pregnancy should express not the arrival of a son and heir, nor the responsibility of a new dependant to be provided for, not even the relief from long weeks of anxiety, but simply the physical pain endured by the mother. It is also noteworthy that to impress the highest flights of mental and physical endurance and suffering, men have used words which refer to the pains of motherhood. Let us examine, therefore, some of the views which have been held concerning the nature and cause of these pains.

"In sorrow thou shalt bring forth children," was the curse of the Garden of Eden, and the spirit of this people for centuries regarded labour pains as an heritage of womankind to expiate for the sins of their early parents. It is less than a hundred

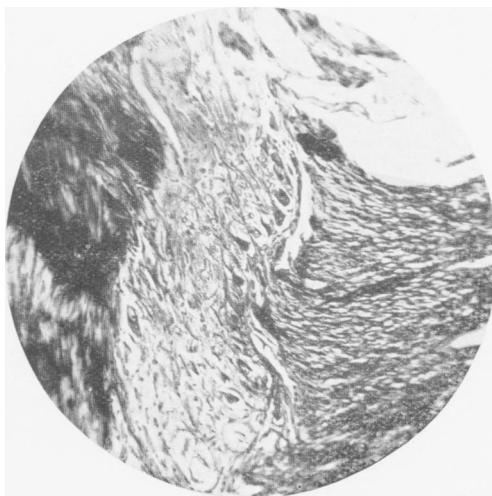


Fig. 1 — Canis familiaris



Fig. 2 — Felis domesticus

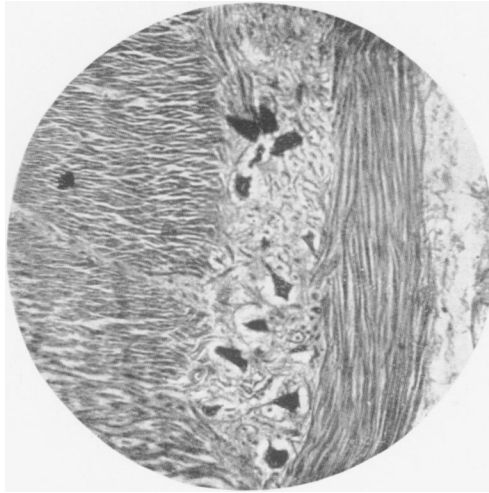


Fig. 3 – *Herpestes fasciatus*

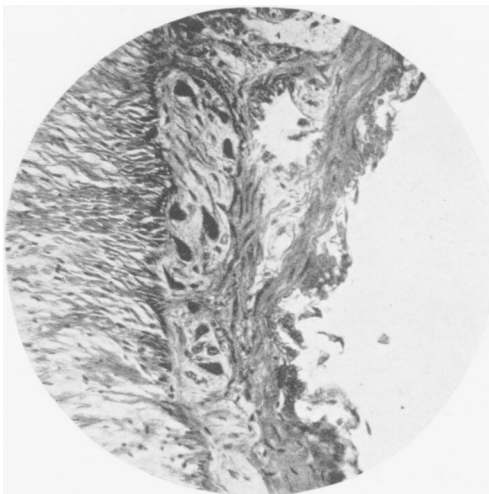


Fig. 4—*Hapale jacchus*

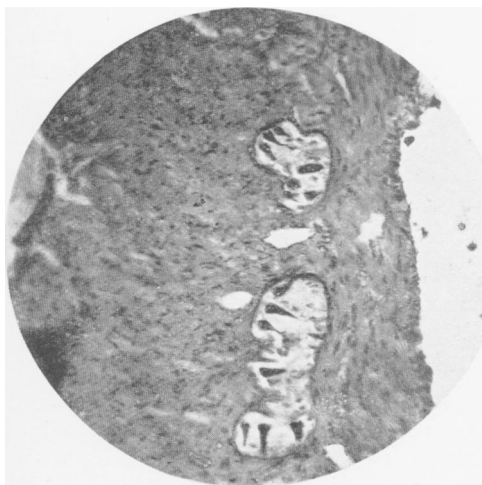


Fig. 5—Mus albicans



Fig. 6—Lepus cuniculus